



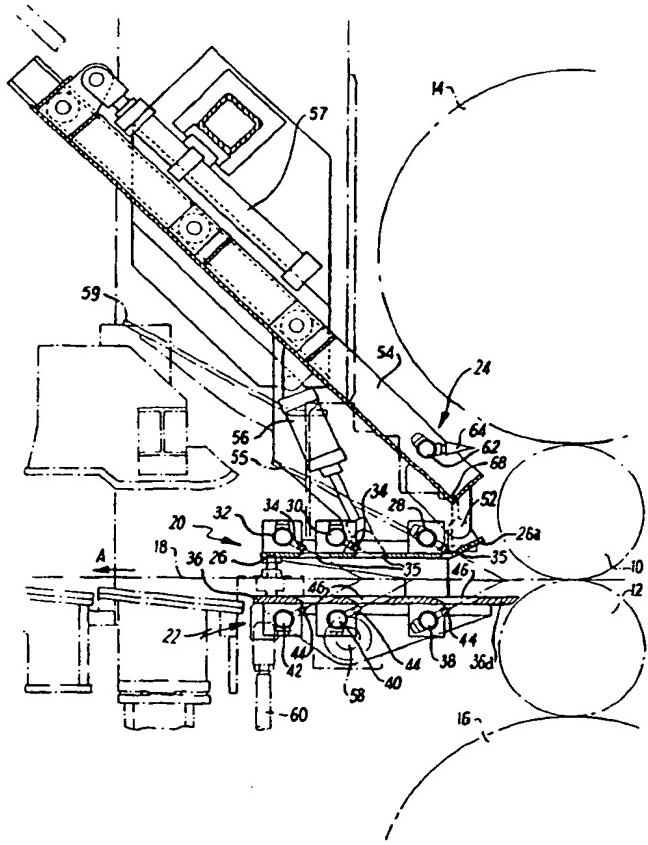
## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(54) Title: APPARATUS FOR USE IN ROLLING MILLS

## (57) Abstract

Strip material moves along a pass line (18) through work rolls (10, 12) of a rolling mill. The strip is sprayed with a lubricant before contacting the work rolls (10, 12). Apparatus for removing the lubricant and drying the strip after rolling and before reeling uses air jets produced by nozzle assemblies (20, 22) above and below the pass line (18). The nozzle assemblies (20, 22) are located in close proximity to the pass line (18). The air jets are substantially confined by wall elements lined with energy absorbing material (Fig. 4). The nozzle assemblies (20, 22) are mounted so as to be readily movable out of the vicinity of the roll stand.



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1       "Apparatus for use in Rolling Mills"

2

3       This invention relates to apparatus for use in rolling  
4       mills for the purpose of removing fluids from the strip  
5       surface at the exit side of the roll stand.

6

7       In the cold rolling of aluminium strip, it is  
8       conventional to use a liquid lubricant such as kerosene  
9       which is sprayed onto the strip at the input side of  
10      the roll stand. It is desirable to remove the lubricant  
11      and thus dry the strip before the rolled strip is  
12      reeled; failure to do so may lead to the lubricant, or  
13      more especially contaminants carried by the lubricant,  
14      causing staining or spotting of the strip.

15

16      It is known to remove the lubricant by directing jets  
17      of compressed air at the top and bottom surfaces of the  
18      strip as it exits the roll stand. However, the known  
19      apparatus for achieving this have not been entirely  
20      satisfactory in achieving the desired quality of the  
21      finished strip, and also have a significant  
22      disadvantage of producing a large volume of spray or  
23      mist of lubricant in the area of the roll stand.

24

25      An object of the present invention is to provide an

1 improved apparatus in which the foregoing disadvantages  
2 are overcome or mitigated.

3

4 Accordingly, the present invention provides apparatus  
5 for use in removing a lubricant from the surface of  
6 strip exiting from a roll stand of a rolling mill, the  
7 apparatus comprising upper and lower nozzle assemblies  
8 positioned above and below the strip path to project a  
9 pressurised fluid onto the upper and lower surfaces of  
10 the strip in a direction towards the roll stand exit  
11 and at a vertical angle which forms an acute angle with  
12 the strip path the nozzle assemblies being positioned  
13 adjacent the strip; and the apparatus further including  
14 confinement means positioned around the discharge of  
15 the nozzle assemblies to confine within the vicinity of  
16 the strip at least a substantial portion of any  
17 lubricant forced off the surface of the strip by the  
18 pressurised fluid.

19

20 Preferably, said pressurised fluid is air and said  
21 lubricant is a liquid.

22

23 Preferably, the apparatus includes a further nozzle  
24 assembly positioned to direct pressurised air into the  
25 bite between an upper work roll and an upper backup  
26 roll of the roll stand.

27

28 In a particularly preferred form of the invention, the  
29 containment means includes carrier plates for the  
30 nozzles and end plates, and at least part of the  
31 interior surface of the containment means is provided  
32 with an energy absorbing material, suitably in the form  
33 of wire mesh.

34

35 The nozzles are preferably arranged so as to create one  
36 or more transverse rows of fluid impact areas which are

1 positioned so as to extend across the width of the  
2 strip but without the impact areas overlapping.  
3

4 The nozzle assemblies are preferably mounted in such a  
5 manner as to be closely adjacent the strip path and the  
6 roll stand exit when in use, while being readily moved  
7 to inoperative positions allowing easy access to the  
8 roll stand exit area.  
9

10 An embodiment of the invention will now be described,  
11 by way of example only, with reference to the  
12 accompanying drawings, in which:

13 Fig. 1 is a cross-sectional side view of apparatus  
14 forming one embodiment of the invention and part of an  
15 associated roll stand of a rolling mill;  
16

17 Fig. 2 is a plan view of an air nozzle assembly used in  
18 the apparatus of Fig. 1, illustrating the jet pattern  
19 produced by the air nozzle assembly;  
20

21 Fig. 3 is a plan view of another air nozzle assembly  
22 used in the apparatus of Fig. 1; and  
23

24 Fig. 4 is a schematic end view of the apparatus of  
25 Fig. 1.

27 Referring to Fig. 1, the apparatus of the present  
28 embodiment is used in conjunction with a roll stand  
29 having upper and lower working rolls 10 and 12 and  
30 upper and lower backup rolls 14 and 16. The strip  
31 travels through the roll stand along the path  
32 indicated at 18 in the direction of the arrow A. The  
33 rolling mill itself may be any conventional mill and is  
34 therefore shown in outline in sufficient detail only to  
35 indicate the relationship between the mill and the  
36

1 apparatus of the present invention.

2

3 Lubricant is sprayed onto the strip in well known  
4 manner at the entrance side to the roll stand by means  
5 not shown. The apparatus of Fig. 1 is used to remove  
6 the lubricant and dry the strip before the latter is  
7 reeled on a reel stand (not shown).

8

9 The apparatus includes an upper nozzle assembly 20 and  
10 a lower nozzle assembly 22 disposed above and below the  
11 strip path. These assemblies are supplied with  
12 pressurised air which is blown onto the strip, in a  
13 manner to be described in greater detail below, so as  
14 to blow the lubricant to the sides of the strip and  
15 from there to blow it clear of the strip. The apparatus  
16 also includes a backup roll nozzle assembly 24 which  
17 directs pressurised air at the bite between the upper  
18 work roll 10 and the upper backup roll 14, as will also  
19 be described in greater detail below.

20

21 The upper nozzle assembly 20 comprises a carrier plate  
22 on which are mounted three header bars 28, 30, 32  
23 extending transversely of the strip. Each header bar  
24 28, 30, 32 mounts a number of nozzles 34 directed  
25 towards the top surface of the strip via apertures 35  
26 in the carrier plate 26. Similarly, the lower nozzle  
27 assembly 22 comprises a carrier plate 36 mounting  
28 header bars 38, 40, 42 carrying nozzles 44 directed at  
29 the bottom surface of the strip via apertures 46.

30

31 Each of the header bars is supplied with dry  
32 pressurised air via suitable hoses (not shown), and the  
33 pressurised air is discharged through the nozzles 34,  
34 44 to remove lubricant from the strip. As seen in Fig.  
35 1, the nozzles 34, 44 are disposed to discharge air at  
36 a vertical angle  $\alpha$  which is typically in the range 25°

1 to 35°.

2

3 Fig. 2 illustrates the disposition and effect of the  
4 nozzles 34 on one header bar 28; the other header bars  
5 are arranged in an identical manner. The nozzles 34 (in  
6 this embodiment, nine nozzles on each header bar) are  
7 disposed at varying horizontal angles to the strip axis  
8 to produce air contact areas 48 on the strip 50 of  
9 generally elliptical shape and at varying angles to the  
10 strip axis across the width of the strip. This pattern  
11 promotes flow of the lubricant to the sides of the  
12 strip and thereafter detachment of the lubricant from  
13 the sides of the strip. It will also be noted that the  
14 air contact areas 48 overlap across the width of the  
15 strip, but do not mix with each other. This arrangement  
16 ensures that the whole width of the strip is wiped  
17 while avoiding turbulence which would be produced if  
18 the discharge from adjacent nozzles were allowed to  
19 mix.

20

21 This pattern of air impact can suitably be produced by  
22 nozzles having discharge openings of rectangular shape,  
23 typically about 15 mm x 5 mm, supplied with air at a  
24 pressure of the order of 4 - 5 bar.

25

26 Referring again to Fig. 1, the upper carrier plate 26  
27 is hinged at 52 to a support member 54 and may be  
28 pivoted about 52 to a position shown at 55 in phantom  
29 by operation of an air cylinder 56. The support member  
30 54 in turn is mounted for sliding movement by a  
31 hydraulic cylinder 57 to an upper position shown at 59  
32 in phantom. The lower carrier plate 36 is pivotally  
33 mounted at 58 about which point it may be swung  
34 anticlockwise by a hydraulic cylinder or the like (not  
35 shown) operating through a connecting rod 60, after the  
36 upper assembly has been withdrawn, into a substantially

1 vertical position. These movements of the upper and  
2 lower assemblies take the present apparatus out of the  
3 immediate vicinity of the roll stand in a simple and  
4 convenient manner, to allow work to be carried out on  
5 the roll stand such as changing rolls.

6

7 This mounting arrangement also has the advantage that,  
8 in the event of a misfeed of the strip in the exit area  
9 of the roll stand, the nozzle assemblies can readily be  
10 swung clear to provide access for remedial action.

11

12 The support member 54 also acts as a mounting for the  
13 backup roll nozzle assembly 24. The assembly 24  
14 comprises a header bar 62 which is rotatably mounted in  
15 the support member 54 and may be angularly adjusted (by  
16 means such as a hand-driven rack and pinion, not shown)  
17 to be aimed accurately at the bite between the upper  
18 backup roll 14 and the upper work roll 10. The header  
19 bar 62 carries a number of nozzles, as seen in Fig. 3,  
20 comprising a central, fishtail shaped nozzle 64 and  
21 angled side nozzles 66. The purpose of the assembly is  
22 to avoid a build up of lubricant in the bite area which  
23 would tend to be scattered or sprayed by the rotation  
24 of the rolls. The angular adjustment of the assembly 24  
25 allows it to be aligned with rolls of different sizes,  
26 or to be adjusted to cope with wear of the rolls.

27

28 The support member 54 is formed in this embodiment as  
29 an open-topped tray, which assists by intercepting  
30 lubricant drops or mist which would otherwise fall  
31 towards the strip, the intercepted lubricant then being  
32 discharged by gravity through drain holes such as 68.

33

34 In the present embodiment, the upper and lower nozzle  
35 assemblies 20 and 22 are positioned in close proximity  
36 to the strip 50, typically in the range 50 - 250 mm and

1 preferably about 150 mm; this contrasts with prior art  
2 arrangements in which air nozzles are typically  
3 directed at the strip from a distance of the order of  
4 1 m. This allows a much more accurate air blast  
5 pattern and reduces the spread of lubricant spray and  
6 droplets. The lubricant is further confined by  
7 substantially enclosing the area of the nozzle  
8 assemblies. As best seen in Fig. 4, the area in  
9 question is closed at the sides by side plates 70 and  
10 at the top and bottom by the carrier plates 26 and 36.  
11 The upstream end of this area in the embodiment of  
12 Fig. 1 is confined by a forward extension 36a of the  
13 lower carrier plate 36 configured to act as a stripper  
14 bar on the lower work roll 12, and an end portion 26a  
15 projecting from the upper carrier plate 26 towards the  
16 upper work roll 10. In an alternative, shown  
17 schematically in Fig. 4, the upstream end of this area  
18 is confined by a pair of vertical end plates 72 and 74  
19 forming a narrow slot 75 for passage of the strip. A  
20 similar arrangement may be disposed at the downstream  
21 end of the area.

22  
23 This arrangement substantially reduces the general  
24 spread of lubricant spray or droplets. It is however  
25 possible for such lubricant to bounce from the  
26 confinement back onto the strip. To overcome this  
27 problem, it is preferred to line at least part of the  
28 area with an energy absorbent material as indicated at  
29 76 in Fig. 4. The material 76 should be such as to  
30 absorb the kinetic energy of impacting lubricant so  
31 that the lubricant is retained in the area of the wall  
32 and runs by gravity to a suitable discharge. A  
33 preferred material for this purpose is a mesh of fine  
34 stainless steel wire, but other material may be used,  
35 such as bristles of metal or plastics which are  
36 resistant to the lubricant material and the temperature

1       of operation.

2

3       The invention is of particular usefulness in the cold  
4       rolling of aluminium strip, and has been shown to give  
5       excellent results in rolling aluminium strip in widths  
6       of 0.9 m - 2.0 m in finished thicknesses down to  
7       0.2 mm. It is believed that the invention would be  
8       useful also in other rolling processes such as the cold  
9       rolling of steel strip.

10

11      Modifications may be made to the foregoing embodiment  
12      within the scope of the invention.

13

14      For example, the air nozzles in a given transverse row  
15      of nozzles may be supplied with pressurised air  
16      independently, instead of via a common header. This  
17      makes it possible to use different pressures at  
18      different locations across the width of the strip,  
19      suitably a higher pressure in the centre and  
20      progressively lower pressures towards the sides. It  
21      also makes it possible to disable the air supply to the  
22      outer nozzles when rolling strip of a width less than  
23      the full width capacity of the mill, thereby saving on  
24      compressed air consumption.

25

26      The upper and lower nozzle assemblies may be  
27      constructed so that the vertical and horizontal angles  
28      of discharge of the nozzles may be adjusted. This  
29      simplifies adjusting the apparatus to deal with  
30      different thicknesses and widths of material.

31

1       CLAIMS

2

3       1. Apparatus for use in removing a lubricant from the  
4       surface of strip exiting from a roll stand of a rolling  
5       mill, the apparatus comprising upper and lower nozzle  
6       assemblies positioned above and below the strip path to  
7       project a pressurised fluid onto the upper and lower  
8       surfaces of the strip in a direction towards the roll  
9       stand exit and at a vertical angle which forms an acute  
10      angle with the strip path the nozzle assemblies being  
11      positioned adjacent the strip; and the apparatus  
12      further including confinement means positioned around  
13      the discharge of the nozzle assemblies to confine  
14      within the vicinity of the strip at least a substantial  
15      portion of any lubricant forced off the surface of the  
16      strip by the pressurised fluid.

17

18      2. Apparatus according to claim 1, in which said  
19      pressurised fluid is air and said lubricant is a  
20      liquid.

21

22      3. Apparatus according to claim 2, including a further  
23      nozzle assembly positioned to direct pressurised air  
24      into the bite between an upper work roll and an upper  
25      backup roll of the roll stand.

26

27      4. Apparatus according to any preceding claim, in  
28      which the upper nozzle assembly includes a plurality of  
29      nozzles mounted on an upper carrier plate, and the  
30      lower nozzle assembly includes a plurality of nozzles  
31      mounted on a lower carrier plate, each nozzle  
32      projecting pressurised fluid via a corresponding  
33      aperture in the respective plate; and in which the  
34      containment means comprises said carrier plates and end  
35      plates on either side of the strip path.

36

1       5. Apparatus according to claim 4, in which at least  
2       part of the inner surface of the containment means is  
3       provided with an energy absorbing material.

4

5       6. Apparatus according to claim 5, in which said  
6       energy absorbing material is a layer of wire mesh.

7

8       7. Apparatus according to any preceding claim, in  
9       which each of the upper and lower nozzle assemblies  
10      comprises at least one row of nozzles disposed  
11      transverse to the strip axis, the nozzles in the or  
12      each row being so formed and positioned as to produce  
13      on the surface of the strip a series of impact zones of  
14      pressurised fluid extending generally transversely of  
15      the strip at varying shallow angles to the transverse  
16      direction of the strip so as to overlap in the  
17      transverse but not in the axial direction of the strip.

18

19       8. Apparatus according to claim 7, in which each of  
20      the upper and lower nozzle assemblies comprises three  
21      transverse rows.

22

23       9. Apparatus according to claim 7 or claim 8, in which  
24      each transverse row comprises a number of nozzles  
25      mounted on and fed from a transverse header bar at a  
26      common pressure.

27

28       10. Apparatus according to claim 7 or claim 8, in  
29      which the pressure of fluid supplied to the nozzles of  
30      a given row may be varied across the width of the  
31      strip.

32

33       11. Apparatus according to any preceding claim, in  
34      which the upper and lower nozzle assemblies are mounted  
35      on upper and lower support means each movable between  
36      an operative position in which the nozzles are closely

11

1 adjacent the strip path at the exit from the roll stand  
2 and an inoperative position allowing access to said  
3 exit.

4

5 12. Apparatus according to claim 11, in which the upper  
6 nozzle assembly is pivoted on a support member disposed  
7 above at an angle to the strip path, and the support  
8 member is movable toward and away from the roll stand.

9

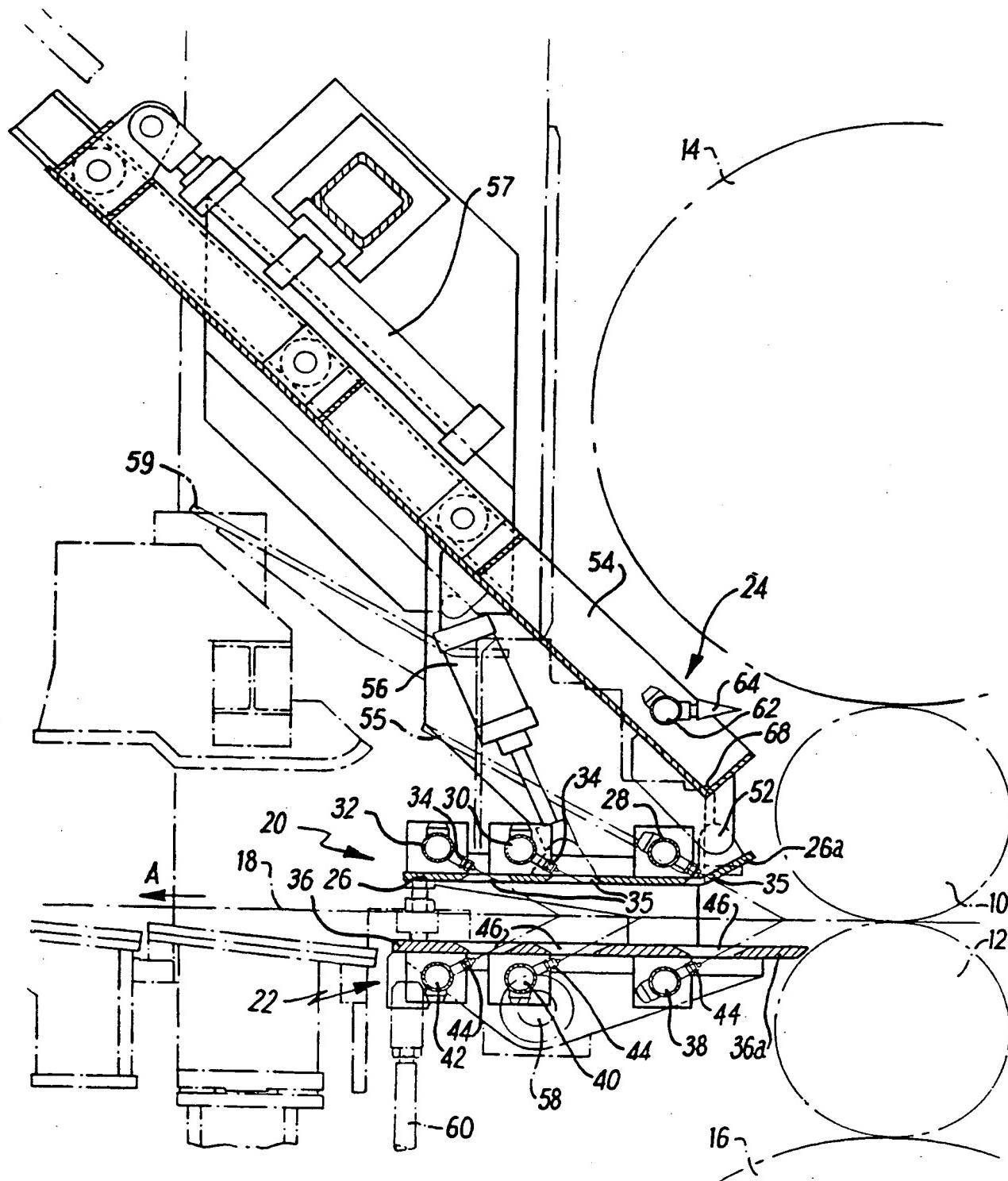
10 13. Apparatus according to claim 3 and claim 12, in  
11 which the support member carries said further nozzle  
12 assembly.

13

14 14. Apparatus according to claim 13, in which the  
15 support member is in the form of an tray open towards  
16 the upper backup roll.

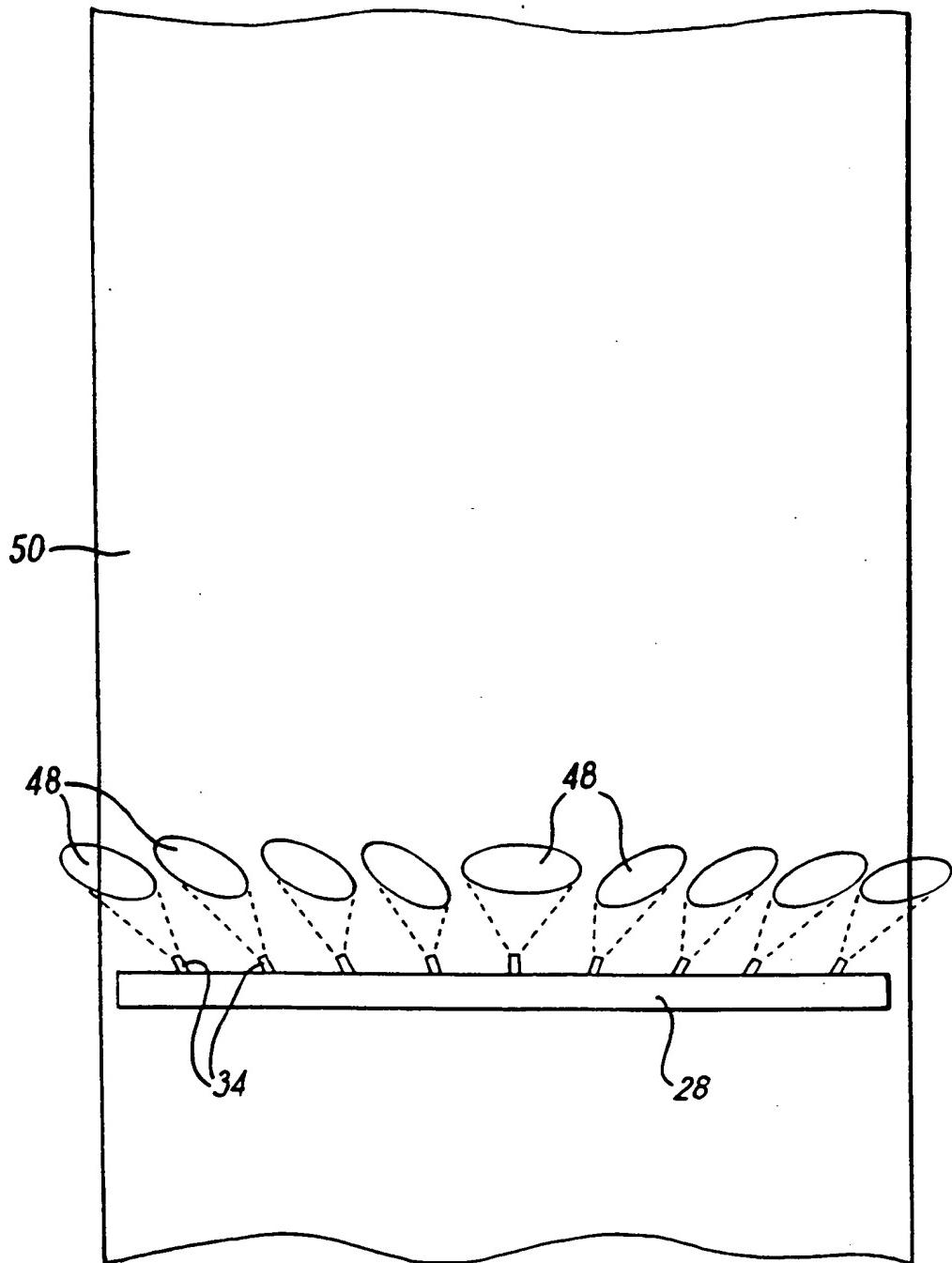
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FIG. 1

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FIG. 2

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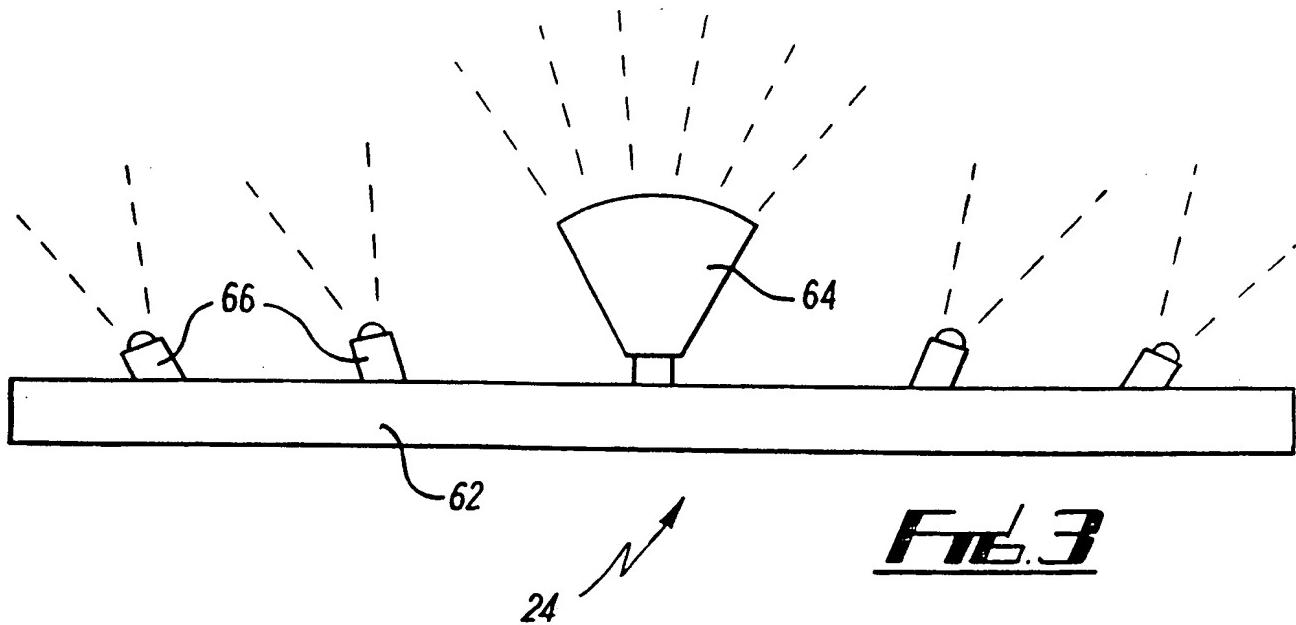


FIG. 3

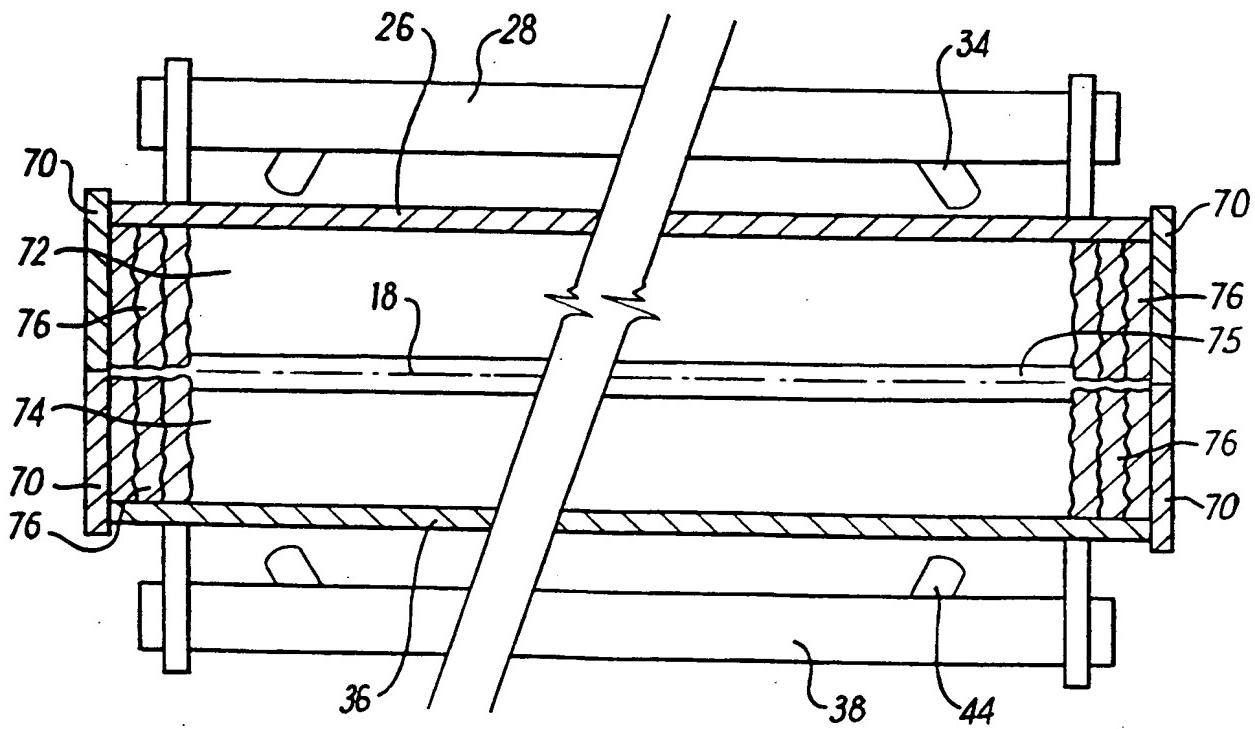


FIG. 4

## INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 94/01774

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 B21B45/02 B21B27/10

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 B21B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	PATENT ABSTRACTS OF JAPAN vol. 4, no. 53 (M-008) 19 April 1980 & JP,A,55 022 434 (HITACHI) 18 February 1980 see abstract	1,2,4,7, 9,11
A	---	5,12
X	GB,A,2 111 885 (WEAN UNITED INC) 13 July 1983 see page 2 - page 4; figures 2,5-10	1,2,4, 11,12
X	US,A,3 192 752 (DOWD ET AL.) 6 July 1965 see column 3 - column 4; figures 1-4	1,2,4
A	---	3,5,7,9, 10,13
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1	Date of the actual completion of the international search  16 November 1994	Date of mailing of the international search report  29. 11. 94
	Name and mailing address of the ISA  European Patent Office, P.B. 5818 Patentdaan 2 NL - 2280 HV Rijswijk Tel. (+ 31-70) 340-2040, Tx. 31 651 epo nl, Fax (+ 31-70) 340-3016	Authorized officer  Rosenbaum, H

## INTERNATIONAL SEARCH REPORT

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## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US,A,4 601 112 (KUSH ET AL.) 22 July 1986 see column 3; figures 1,1A	1,2,4
A	---	5,7,9
X	PATENT ABSTRACTS OF JAPAN vol. 8, no. 132 (M-303) 20 June 1984 & JP,A,59 033 022 (HITACHI SEISAKUSHO) 22 February 1984 see abstract	1,2
A	---	4,5
A	PATENT ABSTRACTS OF JAPAN vol. 4, no. 12 (C-71) 29 January 1980 & JP,A,54 145 355 (KOBE SEIKOSHO) 13 November 1979 see abstract	1-3,7,9, 13,14
A	---	
A	PATENT ABSTRACTS OF JAPAN vol. 3, no. 100 (C-56) 24 August 1979 & JP,A,54 078 348 (HITACHI SEISAKUSHO) 22 June 1979 see abstract	1,2,4,7, 9,10
A	---	
P,A	PATENT ABSTRACTS OF JAPAN vol. 17, no. 379 (M-1447) 16 July 1993 & JP,A,05 069 028 (KAWASAKI STEEL) 23 March 1993 see abstract	1-4,13
P,A	---	
P,A	PATENT ABSTRACTS OF JAPAN vol. 18, no. 254 (M-1605) 16 May 1994 & JP,A,06 039 422 (SUMITOMO LIGHT METAL IND.) 15 February 1994 see abstract	1-3,13
	-----	

## INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 94/01774

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB-A-2111885	13-07-83	AU-A- 9091782 CA-A- 1230764 JP-A- 58110115 US-A- 4691549	30-06-83 29-12-87 30-06-83 08-09-87
US-A-3192752		NONE	
US-A-4601112	22-07-86	NONE	

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